

TECHNICAL REVIEWERS' RATING SUMMARY

G-018A

Bakken Water Opportunities Assessment

Submitted by Energy & Environmental Research Center

Principal Investigator: Daniel J. Stepan

Request for \$110,000; Total Project Costs \$230,000

Rating Category	Weighting Factor	Technical Reviewer		Average Weighted Score
		18A-01 Rating	18A-02 Rating	
Objective	9	4	5	40.5
Availability	9	4	4	36.0
Methodology	7	3	5	28.0
Contribution	7	3	5	28.0
Awareness	5	3	4	17.5
Background	5	4	5	22.5
Project Management	2	3	3	6.0
Equipment Purchase	2	5	3	8.0
Facilities	2	5	5	10.0
Budget	2	4	5	9.0
Average Weighted Score		183	228	205.5
Maximum Weighted Score				250

OVERALL RECOMMENDATION

FUND	X	X
<u>FUNDING TO BE CONSIDERED</u>		
DO NOT FUND		

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1. The objectives or goals of the proposed project with respect to clarity and consistency with North Dakota Industrial Commission/Oil and Gas Research Council goals are: 1 – very unclear; 2 – unclear; 3 – clear; 4 – very clear; or 5 – exceptionally clear.

Reviewer 18A-01 (Rating: 4)

The following statutory goals and purposes and grant priorities are specifically consistent with the goals and objectives of this proposal:

Statutory Goals & Purposes

- Promote efficient, economic and environmentally sound exploration, development, and use of North Dakota's oil and gas resources.
- Encourage, and promote the use of new technologies and ideas that will have a positive economic and environmental impact on oil and gas exploration, development, and production in North Dakota.

Grant priority is to be given to those development projects, processes, ideas, and activities which meet the following goals and objectives:

- Identify oil and gas exploration and production technologies presently not used in North Dakota.
- Improve the overall suitability of the oil and gas energy industry in North Dakota through the development of new environmental practices that will help to reduce the footprint of oil and gas activities.
- Develop baseline information that will lead to other projects, processes, ideas, and activities.

Reviewer 18A-02 (Rating: 5)

As outlined in the proposal, the economic recycling of frac flowback water will increase efficiencies in fracture treatment by lowering water acquisition and transportation costs. It will reduce overall truck traffic which in turn will reduce dust which can be a significant impact to local residents. The economic reuse of frac flowback water will also reduce disposal costs which improves the economics of oil exploration which frees up capital to invest in more exploration. Reuse of frac flowback water will also reduce competition for fresh water resources and/or conserve it for other beneficial uses. Fresh water is critical to energy development and conserving its use is highly desirable and will promote good will with others who rely on fresh water for domestic, agricultural, and other purposes as well as promote the oil and gas industry as good corporate neighbors and citizens.

The reduction in truck traffic will have additional benefits such as reducing the impact caused by dust to livestock that may be in the area and will promote positive relationships with people living and working in the area. Reduced truck traffic will also reduce the risk of transportation related accidents, accidental discharges, as well as wear and tear on highways and local roads.

2. With the approach suggested and time and budget available, the objectives are: 1 – not achievable; 2 – possibly achievable; 3 – likely achievable; 4 – most likely achievable; or 5 – certainly achievable.

Reviewer 18A-01 (Rating: 4)

No comment

Reviewer 18A-02 (Rating: 4)

The approach, time table, and budget seem very reasonable and achievable. The project includes appropriate steps to achieve its goals. It also includes public outreach which, if the project determines recycling of frac flowback water is feasible, is necessary to publicize and promote frac flowback water recycling and encourage its widespread use to realize the maximum benefit.

3. The quality of the methodology displayed in the proposal is: 1 – well below average; 2 – below average; 3 – average; 4 – above average; or 5 – well above average.

Reviewer 18A-01 (Rating: 3)

Appears adequate without need for complex methodology.

Reviewer 18A-02 (Rating: 5)

The methodology suggested in the proposal is very good and well thought out.

4. The scientific and/or technical contribution of the proposed work to specifically address North Dakota Industrial Commission/Oil and Gas Research Council goals will likely be: 1 – extremely small; 2 – small; 3 – significant; 4 – very significant; or 5 – extremely significant.

Reviewer 18A-01 (Rating: 3)

The scientific and technical contribution will be significant, though quite a bit will be compilation and review of existing data and methodologies used elsewhere.

Reviewer 18A-02 (Rating: 5)

As outlined in the proposal, the scientific and technical contribution to the oil and gas industry of North Dakota has enormous potential. Successful implementation of frac flowback water recycling will minimize water use, water acquisition costs, disposal costs, and truck traffic. Depending on the technology implemented, natural gas could be used as a power source, thereby making use of gas currently flared in exploration areas. Successful implementation will lead to new jobs for skilled water treatment professionals.

Successful implementation could also lead to the start up of new companies specializing in frac flowback water recycling. It also would provide for expansion of existing companies to provide a variety of services. New or existing companies would be needed to implement the service, provide for laboratory analysis, fabricate equipment, provide power, etc.

5. The principal investigator's awareness of current research activity and published literature as evidenced by literature referenced and its interpretation and by the reference to unpublished research related to the proposal is: 1 – very limited; 2 – limited; 3 – adequate; 4 – better than average; or 5 – exceptional.

Reviewer 18A-01 (Rating: 3)

The principal investigator's awareness of current research activity appears adequate.

Reviewer 18A-02 (Rating: 4)

Project includes site visits to current operating frac flowback water recycling locations in the Barnett Shale play in Texas. The project will further develop the knowledge-base on frac flowback water recycling and its applicability to the Bakken Shale play in North Dakota.

6. The background of the investigator(s) as related to the proposed work is: 1 – very limited; 2 – limited; 3 – adequate; 4 – better than average; or 5 – exceptional.

Reviewer 18A-01 (Rating: 4)

The background of the investigators appears better than average and the collective background and experience of EERC, the sponsoring organization is exceptional.

Reviewer 18A-02 (Rating: 5)

The applicant is highly qualified to carry out the proposal. The amenities available to facilitate the project and ensure its success, such as staff, laboratory facilities, database design capabilities, GIS programming, predictive modeling, and DOE relationship, are exceptional.

7. The project management plan, including a well-defined milestone chart, schedule, financial plan, and plan for communications among the investigators and subcontractors, if any, is: 1 – very inadequate; 2 – inadequate; 3 – adequate; 4 – very good; or 5 – exceptionally good.

Reviewer 18A-01 (Rating: 3)

No comment.

Reviewer 18A-02 (Rating: 3)

The schedule, milestone chart, and budget are well-defined. Unclear as to the plan for communication between investigators and/or industry.

EERC Response

A successful project requires that the Energy & Environmental Research Center (EERC) work closely with industry as both phases of the project are conducted. Routine phone, e-mail, and written correspondence between the EERC, project sponsors, and industry will occur. Additionally, the Oil and Gas Research Council (OGRC) and the North Dakota Petroleum Council will receive copies of quarterly technical progress reports that are submitted to the U.S. Department of Energy.

8. The proposed purchase of equipment is: 1 – extremely poorly justified; 2 – poorly justified; 3 – justified; 4 – well justified; or 5 – extremely well justified. (Circle 5 if no equipment is to be purchased.)

Reviewer 18A-01 (Rating: 5)

No equipment is proposed for the initial phase of the project. If Phase II is selected there probably will be some equipment required, unless it is purchased by a contributing partner. No information on that equipment was provided and it would need to be evaluated at that time.

Reviewer 18A-02 (Rating: 3)

Budget allows \$2535 for supplies but these are not defined. However, this is a small dollar amount and it is to be funded by entities outside the NDIC Oil and Gas Research Council.

9. The facilities and equipment available and to be purchased for the proposed research are: 1 – very inadequate; 2 – inadequate; 3 – adequate; 4 – notably good; or 5 – exceptionally good.

Reviewer 18A-01 (Rating: 5)

The facilities at EERC are excellent.

Reviewer 18A-02 (Rating: 5)

EERC is a well known leader in research projects.

10. The proposed budget “value”¹ relative to the outlined work and the financial commitment from other sources is of: 1 – very low value; 2 – low value; 3 – average value; 4 – high value; or 5 – very high value.

Reviewer 18A-01 (Rating: 4)

The “value” appears to have the potential of being very beneficial to the State of North Dakota, both economically in terms of money saved, and environmentally in terms of the conservation of resources. The NDIC is being asked to provide less than 50%, which is favorable.

Reviewer 18A-02 (Rating: 5)

The economic implementation of frac flowback water recycling in the Bakken Shale play is of unlimited value, both economically and environmentally, to the State of North Dakota, the oil and gas industry, and the citizens of North Dakota. The requested cost-share from the NDIC Oil and Gas Research Council of \$25,000 for phase I and \$85,000 for phase II is a great value and the investment will pay for itself many times over if this technology proves feasible.

Section C. Overall Comments and Recommendations:

Please comment in a general way about the merits and flaws of the proposed project and make a recommendation whether or not to fund.

Reviewer 18A-01 (Fund)

The issue of conserving water resources in western North Dakota is of critical importance and concern to both landowners and industry. Frac water is one of the largest water uses in the oil industry. Finding alternate methods that are economic to reuse/recycle the water would provide tangible benefits to the state and industry.

It appears that the only recycling or beneficial reuse option that is being considered is reuse as frac water. If this is the case then the list of analytical parameters in Table 1 should be adequate. However, if other potential beneficial uses are to be considered, then additional parameters would provide valuable data in evaluating the suitability of the water for various purposes, or to determine what water treatment options would be needed. Additional parameters that may be of interest include complete inorganic mineral chemistry, trace metals, VOC’s and SVOC’s.

EERC Response

While the proposed research is intended to assess the potential for reuse as frac water, if another suitable beneficial use is identified, the EERC would provide a more complete analytical characterization of the water.

Reviewer 18A-02 (Fund)

The overall concept to recycle frac flowback water is highly desirable and provides many tangible and intangible benefits. It is environmentally sound to reduce fresh water consumption and create a beneficial use for water that is otherwise a waste product requiring disposal.

Even if the project determines frac flowback water recycling is not feasible at this time, valuable background information will be obtained relative to fresh water sources and what the obstacles

are for future projects to successfully recycle frac flowback water when and if new technologies are developed. This project may also lead to other beneficial uses for frac flowback water.

One aspect of the proposal that was questionable was the transportation of recycled frac flowback water via pipeline or hose to another site for use. It seems this would not be feasible due to lack of infrastructure and the cost and labor to lay temporary flowlines or hoses as well as obstacles that may be present. Cold weather may also render this unfeasible.

I highly recommend funding of this project.

EERC Response

This methodology was presented as an alternative to truck transportation in cases where it may be feasible. Transport via hose that is dragged across the landscape is a common practice in other oilfield applications, as well as in the agricultural industry where manure slurries, for example, are pumped at distances greater than 2 miles through 6- to 8-inch-diameter flexible hose to accommodate land application. It is duly noted that this may be impractical in winter temperature conditions.